REMARKS/ARGUMENTS

The office action of May 12, 2009 has been carefully reviewed and these remarks are responsive thereto. Reconsideration and allowance of the instant application are respectfully requested. Claims 1-20 were the claims as originally filed and claims 1-7 noted as canceled in the preliminary amendment were the claims as amended during the International Stage.

To clarify, claims 1-20 are now indicated as canceled, and claims 8-11 and 13-16 which appeared in the preliminary amendment have been rewritten as new claims 21-28 (claim 12 is now incorporated into claim 21). New claims 29-35 have also been added.

Rejections under 35 U.S.C. §§ 102/103

Claims 8-10 and 14-16 (now claims 21-23 and 26-28) stand rejected under 35 U.S.C. § 102(b) as being anticipated by, or under 35 U.S.C. § 103(a) as being unpatentable over, Ali et al. ("Ali).

New claim 21 recites former claim 8 (from preliminary amendment) and further comprises the element of former claim 12, that the body is a tool, and further that the nanocrystalline diamond consists of crystallites of 1-100 nm. Claim 21 is directed to a tool with a cemented carbide substrate and a diamond layer that is smoother than the substrate surface (this is known as a "leveling effect" where the surface roughness Rz of the diamond layer is less than the surface roughness Rz of the substrate surface). Ali does not teach or suggest the claimed tool.

Ali does not describe a diamond coated tool with a cemented carbide substrate. Instead, diamond films are deposited onto silicon substrates (page 297, left column, part II of Ali). Further, the diamond layer deposited in Ali is not nanocrystalline as defined by claim 21. Ali reports on page 298, right column, center, that "the time modulated film consisted of diamond crystallites that were 0.3 μm in size." A layer of 300 nm (0.3 μm) crystallites is not nanocrystalline having crystallites of 1-100 nm as claimed in claim 21.

In contrast, the statement on page 298, left column, III of Ali "the average secondary nucleation crystallite size was in the nanometer range" and on page 298, right column, top, "these newly formed nano-sized diamond grains" refer to fresh nucleated crystallites, not to the

finally created diamond crystallites that make up the coating layer. Thus, Ali clearly does not teach producing a layer of nanocrystalline diamond as claimed.

Further, there is no teaching in Ali related to a "smoothing effect" of a rough substrate, such that the surface of the nanocrystalline diamond layer has a smaller surface roughness than a cemented carbide substrate surface. As recognized in the office action, Ali does not explicitly state the surface roughness of the substrate. Abrasion with diamond powder, as reported on page 297, left column, bottom of Ali, is commonly used in diamond coating to achieve a seeding effect, i.e. generating sites for diamond nucleation. However, such treatment does not allow one to deduce a surface roughness of the generally polished and thus very smooth-silicon substrates.

The surface roughness characteristics of the claimed cemented carbide tools of claim are completely different than those of the silicon substrate of Ali. The surface of cemented carbide tools will invariably be very rough compared to a silicone substrate as used in Ali. There is no teaching in Ali that the diamond layer is smoother than the substrate surface. For example, the TMCVD film shown in fig. 5b of Ali does not show any noticeable smoothing.

In the office action, it is further argued that the smoothing feature is inherent, because Ali teaches a similar method of alternating between a higher carbon oversaturation concentration and a lower oversaturation concentration. This position is respectfully in error. As explained in the specification of the present application on page 5, "the layer gets smoother as a renewed renucleation is initiated more often... the preferred nano-crystalline layers, i.e. crystals of 100 μm or less, are created at 20 alternations or more per 1 μm layer growth. It is particularly preferred when the number of alternations per 1 μm film layer is considerably higher, e.g. at least 200 alternations, or even more than 500 alternations."

New claim 28 (based on claim 16) is directed to a method for CVD diamond coating with process conditions alternating between a first operating state (high carbon over-saturation) and a second operating state (lower carbon over-saturation). In contrast to Ali, the alternations between these two operating states are very rapid: At least 200 alternations per 1 μm of layer growth. Thus, a nanocrystalline diamond layer is obtained, where the surface of the layer has a surface roughness less than the surface roughness of the substrate.

By contrast, in Ali, process parameters are varied only every 8 or 10 minutes (see table II). For the HFCVD system, the growth rate disclosed on page 302, right column, is 3.3 μm/h. Thus, 1 μm of layer growth is achieved within about 18 minutes. During this time period, the process parameters according to table 2 are changed only twice, as compared to 200 alternations claimed in claim 28.

Ali does not teach or suggest claims 21-23 and 26-28 as claimed. Withdrawal of this rejection is requested.

Rejections under 35 U.S.C. § 103

Claims 12-13 (now claims 21 and 25) stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ali in view U.S. patent no. 5,567,522 to Tanabe et al ("Tanabe"). Applicants respectfully traverse this rejection.

Ali does not teach or suggest new claim 21 for the reasons discussed above. Tanabe does not remedy the defects of Ali. Tanabe, while describing a diamond cutting tool, does not describe a layer of nanocrystalline diamond arranged directly on a tool substrate of cemented carbide. Instead, the diamond material is "cut into a desired shape, and then bonded as a cutting edge member (2) to a tool base (1) through a metallization layer (4) and a brazing layer (3)." Tanabe does not teach or suggest nanocrystalline diamond or a surface leveling effect. Withdrawal of the present rejection is requested.

Claim 11 (now claim 24) stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Ali in view of Chen et al. ("Chen"). Claim 11 depended on claim 8 and claim 24 likewise depends on claim 21. Claim 21 contains the limitation formally found in claim 12. Applicants respectfully traverse this rejection.

Ali does not teach or suggest new claim 21 for the reasons discussed above. Chen does not remedy the defects of Ali. Chen discloses nanocrystalline diamond films, but does not teach or suggest application to a cemented carbide tool substrate. Further, Chen does not recognize a smoothing effect.

Ali and Chen are directed to completely different processes and one skilled in the art would not have modified Ali in view of Chen. Ali teaches varying parameters over the coating duration, whereas Chen uses constant parameters. These different approaches cannot easily be combined. Consequently, the features of the resulting layers cannot be combined.

New claim 24 recites unordered, untexturized crystals. The office action states that "Ali et al also teaches polycrystalline diamonds (unordered) and is silent to the crystals having a texture, thus clearly suggests untexturized crystals." That Ali does not explicitly mention a texture does not mean that Ali describes a texture-free structure. That is, one skilled in the art knows that diamond layers created by CVD are texturized and that Ali would have had to explicitly refer to untexturized crystals to "clearly suggest" that the structure was texture-free. Moreover, Fig. 6, for example, illustrates that the film growth mechanism has a texture. In addition, Ali explicitly states on page 298, right column, center that the films "consist of diamond crystals that exhibit predominantly (111) orientation" which is a clear definition of ordered crystals.

Thus a layer of nano-sized (5-100 nm) unordered, untexturized crystals is not taught or suggested by Chen. Chen further does not teach or suggest the claimed method of rapidly alternating between different operating states. Chen does not vary process parameters during the deposition. Thus Chen does not remedy the defects of Ali. Withdrawal of this rejection is requested.

New independent method claim 35 and dependent claim 34 vary process parameters by varying an oxygen flow rate. This is in contrast to Ali which continuously changes a methane flow rate. As explained in the specification on page 13, fourth paragraph of the present application, the inventors recognized that a necessary parameter for formation of diamond is the effective carbon content, i.e. the volume density of the carbon atoms minus the volume density of the oxygen atoms. Because of the formation of thermodynamically stable carbon-monoxide (CO), the addition of oxygen lowers the effective carbon content. Addition of varying quantities of oxygen in the process gas is not recognized in any of the cited prior art documents.

CONCLUSION

It is believed that no fee is required for this submission. If any fees are required or if an overpayment is made, the Commissioner is authorized to debit or credit our Deposit Account No. 19-0733, accordingly.

All rejections having been addressed, applicants respectfully submit that the instant application is in condition for allowance, and respectfully solicit prompt notification of the same.

Respectfully submitted,
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